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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
HAJNIK, DANIEL F	

ART UNIT	PAPER NUMBER
2628	

DATE MAILED: 10/10/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/813,649	SRIVASTAVA ET AL.	
	Examiner	Art Unit	
	Daniel F. Hajnik	2628	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 June 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-6* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,5 and 6* is/are rejected.

7)☒ Claim(s) *4* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *31 March 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. Claim 4 is objected to because of the following informalities: All symbols used in any equations should be defined in the claim, i.e. variables p, q, r, f, and m are not explained as to their meaning in the claims. In particular, these symbols are used in the claimed equations, however, an explanation of what these symbols represent or what these symbols mean is necessary in clearly defining the scope of the claim and further, defining the metes and bounds of the claim language. Appropriate correction is required.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claim 1 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The phrase "such as density" (see line 15- the last line on the first page of claims) renders the claim indefinite because it is unclear whether the limitations following the phrase are part of the claimed invention. See MPEP § 2173.05(d).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 1 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ledru et al. (NPL Document "*GeoFrance3D: an integrated approach to 3D geological and geophysical imaging of the subsurface*", herein referred to as "Ledru") in view of Shirriff (NPL Document "*Generating Fractals from Voronoi Diagrams*", herein referred to as "Shirriff") in further view of Sides (NPL Document "*Geological modeling of mineral deposits for prediction in mining*", herein referred to as "Sides").

As per claim 1, Ledru teaches the claimed "selecting Voronoi centers at a plurality of locations over a region of interest" by teaching of "a 3D solid model of all the geological formations can be constructed automatically using Voronoi diagrams. Starting from a generated set of points issued from the data, this method computes a partition of space according to the nearest neighbour. The constructed solids are topologically closed and share common boundaries" (paragraph right above figure 5) where the set of points may be one or more voronoi centers over a region of interest. Further, data points for a 3D model would most likely use x, y, and z coordinates.

Ledru teaches the claimed "assigning values of physical property variations during generation of the model" by teaching of "attributing densities to each geological unit" (paragraph right after figure 1) and by teaching of "The current approach is to combine geological and geophysical methods to create a '3D exchange system' that will test the modelled 3D imagery resulting from each method" (2nd paragraph in document).

Ledru teaches the claimed "assigning different discrenable representations to regions in the model" in figures 1, 3, 5 where the different shaded areas represent different colors of regions in the models shown.

Ledru does not explicitly teach the claimed "generating an initial model of the subsurface fractal geological object". Shirriff teaches the claimed limitation by teaching of "To generate the fractal images, we start with a small set of points and draw the Voronoi diagram of these points" (2nd paragraph in body of the text).

It would have been obvious to one of ordinary skill in the art at the time of invention to combine Ledru and Shirriff. One advantage to the combination is provided by Shirriff, which teaches of "Voronoi diagrams can be used to generate interesting fractal patterns" (1st paragraph in body of text).

Ledru does not explicitly teach the claimed "the initial model being generated by tessellating". Sides teaches the claimed limitation by teaching of "A polygonal tessellation based on connecting the circumcentres of Delaunay triangles, termed a Voronoi tessellation" (1st full paragraph in 1st col on pg. 346) and by teaching of "3D model building" (2nd full paragraph in 1st col on pg. 346).

It would have been obvious to one of ordinary skill in the art at the time of invention to combine Sides with the combinable system of Ledru and Shirriff. One advantage to the combination is provided by Sides, which teaches of "By weighting the thickness, or other property values, at each vertex according to the area of the corresponding polygon, estimates of volumes and tonnages can be made" (1st full paragraph in 1st col on pg. 346) and by teaching of

"Accurate prediction of the shape, location, size and properties of the solid rock materials to be extracted during mining is essential for reliable technical and financial planning" (abstract).

As per claim 6, Ledru teaches the claimed "geophysical inversion, wherein the tessellated regions are altered by changing the position of Voronoi centers in each iteration" by teaching of "(iii) a modification of the preliminary geological sections on the basis of direct inversion of the gravity data. The dependability of the model was tested by calculating the geophysical response after attributing densities to each geological unit" (paragraph right below figure 1) and by teaching of "a 3D solid model ... using Voronoi diagrams ... the proposed solution allows interpretation-construction reiteration until the model is deemed satisfactory" (paragraph right above figure 5).

6. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ledru in view of Shirriff in further view of Sides in further view of Mishev (NPL Document "*Finite Volume Methods on Voronoi Meshes*", herein referred to as "Mishev").

As per claim 2, Ledru does not explicitly teach the claimed "the fractal subsurface model is generated by modified Voronoi tessellation technique which comprises modifying the Voronoi tessellation by using L^p norm". Mishev teaches the claimed limitation by teaching of "Voronoi meshes" (1st paragraph under section VI) and by teaching of "Results reported for problems 3 and 4 show first-order in the L^2 norm" (1st paragraph under section titled 'Problem 4') where in this case p = 2.

It would have been obvious to one of ordinary skill in the art at the time of invention to combine Mishev with the combinable system of Ledru, Shirriff, and Sides. One advantage to the combination is provided by Mishev, which teaches of applying the L^2 norm effectively to a large number of mesh points (see figure 4 and first paragraph in section VI).

7. Claims 3 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ledru in view of Shirriff in further view of Sides in further view of Archibald et al. (NPL Document "*Multiscale edge analysis of potential field data*", herein referred to as "Archibald").

As per claim 3, Ledru does not explicitly teach the claimed "natural setting of the geological subsurface being modeled is selected from the group consisting of: a sedimentary basin, hydrocarbon deposits, oil reservoirs, aquifers and mineral deposits". Archibald teaches the claimed limitation by teaching of "a function of the subsurface 3D location of contacts between bodies of contrasting density" (3rd paragraph in Introduction), by teaching of "geological mapping purposes such as to map subtle changes in sedimentary sequences" (4th paragraph under Abstract), and by teaching of "Three real datasets at different geographical scales have been analysed ... dataset from a mineralised greenstone terrane in Western Australia" (4th paragraph under Abstract).

It would have been obvious to one of ordinary skill in the art at the time of invention to combine Archibald with the combinable system of Ledru, Shirriff, and Sides. One advantage to the combination is provided by Archibald, which teaches of "The techniques described below aim to improve the current practices of analysis and 3D geological inversion of potential field data. This is achieved by extracting and visualising in 3D the main features in a potential field

map ... these features have a rigorous relationship to subsurface contacts between zones of different density or magnetic susceptibility, and can thus be employed in an inversion strategy" (1st paragraph under the Introduction).

As per claim 5, Ledru does not explicitly teach the claimed "the results are achieved through self-written software, which generates Voronoi tessellated subsurface region and computes a gravity response of the same". However, Ledru suggests this limitation of "self-written software" by teaching of "automatically using Voronoi diagrams ... Since the construction of the solid is automatic" (paragraph right above figure 5). It would have been obvious to one of ordinary skill in the art to incorporate this particular claimed feature into Ledru in order to save the operator's time and energy by using reliable tessellation and gravity response algorithms to perform the work successfully instead of having the operator perform it.

Response to Arguments

8. Applicant's arguments filed 6/19/2006 have been fully considered but they are not persuasive.

Applicant argues:

> Rejection of claims 1 and 6 under 35 U.S.C. 4 103 as allegedly being made "obvious" based on Ledru in view of Shirriff and in further view of Sides is respectfully traversed. Ledru teaches selection of Voronoi centers at a plurality of locations over a region of interest for generation of a three dimensional model. Ledru et al. uses existing Voronoi tessellations which are capable of generation of only polygonal structures. The claimed invention however, relies on fractal based Voronoi tessellation using fractional and negative values of exponent p in L^P norm. Thus, complex irregular structures close to natural settings are generated thereby enabling computations of an expected gravity response thereof. Assigning physical property variation to the regions during generation of models is

> mandatory for any geophysical modeling. The method followed in the invention is neither taught nor guided towards in Ledru et al.
> (bottom of pg. 14 and top of pg. 15 of remarks)

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., "fractional and negative values of exponent p in L^P norm" in regards to claims 1 and 6) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). Further, in regards to the claimed "fractal subsurface structure by Voronoi tessellation", the reference of Ledru only teaches the claimed Voronoi tessellation. The rejection relies upon the reference of Shirriff to teach the claimed " subsurface fractal ", specifically, by teaching of "To generate the fractal images, we start with a small set of points and draw the Voronoi diagram of these points" (2nd paragraph in body of the text).

Applicant argues:

> Shirriff et al. teaches generation of fractal images using existing Voronoi tessellation L^2 norm distance. In Shirriff, the number of Voronoi centers is increased continuously to achieve fractal images. This results in an increase in the number of coordinates and results in cumbersome calculations associated with the computation of each image. The claimed invention, however generates irregular fractal geological structures by changing only exponent 'p' as explained above in fractal based modified Voronoi tessellation. The number of Voronoi centers is not increased. The fractal approach is actually embedded in the tessellation due to modification of exponent 'p' in L^P norm.
> (middle of pg. 15 of remarks)

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., "generates irregular fractal geological structures by changing <u>only</u> exponent 'p' " in regards to claims 1 and 6) are not recited in the rejected claim(s). Although the claims are interpreted in light of the

specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). The examiner acknowledges that claim 6 states "wherein the tessellated regions are altered by changing the position of the Voronoi centers in each iteration", however, the claim language does not indicate that this is the only method of geophysical inversion using the tessellated regions. Further, the reference of Shirriff is not relied upon for teaching this particular limitation, but rather Ledru is relied upon for teaching this particular limitation.

Applicant argues:

> Mishev does not teach the added limitation of claim 2. In Mishev, p=2 in the L^P norm - this is well known as the least square approach and is commonly used in existing Voronoi tessellations. Mishev however does not teach or suggest generation of irregular geometry or irregular geometry or application of fractal or negative norm of distances to generate irregular geometrical models.
> (top of pg. 16 of remarks)

In regards to the above argument, the language of claim 2 states "modifying the Voronoi tessellation by using L^P norm, where p is an exponent which can assume any real value". Even though p=2 is not a fraction or negative number, the claim indicates that the real numbers such as 2 can still be used in the generation process.

Applicant argues:

> Archibald only teaches mapping of subtle changes in sedimentary sequences by multiscale edge analysis of potential field data. Multiscale analysis as taught by Archibald et al. relates to wavelet theory and can only assist in extraction of preliminary information from observed field data for visualization of an underlying object to be used in the inversion. It cannot be used to model complex geological structures lying beneath the Earth's surface.
> (middle of pg. 16 of remarks)

In regards to the above argument, Archibald suggests the combination with the other references which are capable of modeling complex geological structures by stating "The techniques are

tested on a series of synthetic and observed datasets, of varying complexity and geographical scale. The tests show both the effectiveness of the technique as an aid to the geological interpretation of potential field maps and in its use for providing constraints on the three-dimensional geology." (2nd paragraph under Abstract). Here, the abstract suggests complex geological structures by referring to varying the complexity and geographical scale of the datasets. Thus, the prior art rejection in regards to the Archibald reference is proper.

Conclusion

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Daniel F. Hajnik whose telephone number is (571) 272-7642. The examiner can normally be reached on Mon-Fri (8:30A-5:00P).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka J. Chauhan can be reached on (571) 272-7782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Daniel Hajnik 9/28/06

DFH

ULKA CHAUHAN
SUPERVISORY PATENT EXAMINER